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ABSTRACT

This paper describes research using the Educational Resources Information Center--ERIC database to conduct a content analysis of education journals for science teachers. The journals analyzed: "Science and Children" (S&C), "The Science Teacher" (TST), and "The Journal of College Science Teaching" (TJCST), are used by elementary school, high school, and college educators, respectively; and all are publications of the National Science Teachers Association. Journal abstracts were analyzed at 5-year intervals from 1970 to 1990 (n=782). Articles were assessed for their main focus and classified as either teacher-centered, student-centered, or neither. Articles were also assessed for science content. The third method of assessment looked at areas of potential interest to science educators. An instrument developed for the content analysis had an inter-rater reliability of 0.97. Results indicate all of the journals had a major trend for an increased percentage of articles on computer assisted instruction. Other major trends included a percentage decrease in S&C articles on environmental education, an increase in TST articles on the topic of space science, and an increase in TJCST articles on science and society and earth science. Biology was the most represented science content area in all of the journals. While lecturing is commonly used at all levels of instruction, this topic was not present in the S&C and TST sample. The authors conclude that testing and homework received inadequate coverage in S&C and TST, and student-centered instruction and science activities received the majority of coverage. (PR)

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An Abstract Content Analysis of Journals for Science Teachers.

Paper presented at the fourteenth annual meeting of the Mid-Western Educational Research Association.

Oct. 16, 1992

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Introduction:

Journals devoted to classroom science instruction are used by both preservice and inservice teachers. In college education courses, articles from practitioner journals are used as references for reports, sources of in-depth information, and for the development of lesson plans, units, and curricula. In addition to their use in graduate course work, inservice teachers use these journals to ascertain what is happening in their field and for classroom instruction ideas. Thus, education journals contribute to both preservice and inservice teacher education (Cruickshank, 1990) as well as to formal and informal teacher education.

The assumption is made that "respected journals can, and do, influence the future and that the nature of this influence is largely a function of of the editorial decisions which result in the journal's content" (Jinks & Hoffer, 1989, p.181). Educational journals can also influence what is happening in present day classrooms (Cruickshank, 1990). Because of this, analyzing the content of educational journals can not only uncover important trends in the field of education itself, but unearth areas that receive inadequate coverage. This information can be used by writers of articles and editors to help them in developing and selecting meaningful and timely articles. In this article we report the results of a content analysis of three National Science Teacher's Association (NSTA) journals using information from the ERIC database.

The journals Science and Children (S&C), The Science Teacher (TST), and The Journal of College Science Teaching (TJCST) are targeted at teachers of elementary and middle school children, high school students, and college students,

respectively. The NSTA periodicals are directed at the practitioner and frequently contain articles written by practitioners. These journals are found in libraries which serve education students and in school staff rooms. The 50,000 members of the NSTA (Aldridge, 1992) are entitled to receive one publication with their membership. One indicator of the perceived value of these journals is that inservice education programs for teachers have included informative encounters with these and other science education journals (Evans, 1991; Spector & Phillips, 1989).

The NSTA journals are all considered comprehensive journals for the ERIC system, requiring all their feature articles to be abstracted and added to the permanent database. Due to these factors, these journals are widely read and have the potential for impacting science education.

Education journals present articles on instructional strategies which include teaching techniques and methods. Hofwolt (1986) classifies instructional strategies as either teacher-centered or student-centered. "Strategies in which the teacher has direct control are referred to as 'teacher-centered.' Common examples include lectures, demonstrations, teacher-led discussions, and questioning. 'Student-centered' instruction allow students to play a more active or self-guided role. Common examples are laboratory activities, use of learning activity packets, and student-planned activities" (Hofwolt, 1986, p. 46).

The instructional strategy has important implications for the content of the curriculum. According to Schubert (1986), content can be viewed as the subject matter with lectures and textbooks being the dominant purveyors, assisted by workbooks, ditto sheets, and audio visual aids. Content can also be viewed as

learning activities, with the focus on student activity. Programs such as Science-A Process Approach stress learning activities as content (Schubert, 1986).

This analysis considered content as the subject matter to be a teacher-centered approach, and content as activity to be a student-centered approach. A teacher-centered lesson is a lesson where "the spotlight" shines on the teacher. In a student-centered lesson, there would not be one main spotlight, but smaller points of light around the room. The students engage in learning activities with other students or by themselves. The teacher may set up the learning conditions, but the students construct their knowledge independent from the teacher's direct control.

ERIC (Educational Resources Information Center) was established in 1962 as an information analysis center with its main purpose to present information to researchers, teachers, and administrators (Trester, 1981). The ERIC database is the fourth most used database in the United States (Brandhorst & Eustace, 1986). The indexing of journals did not begin until 1969. All of the NSTA journals are comprehensively abstracted by the ERIC Science, Mathematics, and Environmental Education Clearinghouse (ERIC/CSMEE), located at The Ohio State University. This clearinghouse opened in 1966 and soon after Robert Howe became the acting director and continued as director until 1991. Howe, had final authority in all abstracting, selecting, and approving that provided a continuity in the practices of ERIC/CSMEE. The database field is in part composed of a title, names of the authors, descriptors, identifiers, and an abstract. For this analysis the term ERIC abstract will refer to all of these fields.

The ERIC database has been utilized as an important part of educational

research and literature reviews (for example, Helgeson, Blosser, & Howe, 1977; Koehler, 1985; Haury & Rillero, 1992). Questions can be raised as to how well ERIC abstracts represent actual publications. Besides assessing content in NSTA journals, another goal of this study is to determine the efficacy of using the information from an ERIC abstract to do a content analysis.

Problem Statements

This study gathered information to answer the following problem statements:

1) What educational trends are present in Science and Children, The Science Teacher, and The Journal of College Science Teaching during the interval of 1970 to 1990?

2) What are similarities and differences in the content coverage of the three journals?

3) To what extent does the ERIC database for a year of a journal accurately reflect the content of that journal?

Methods.

"Content analysis, though much neglected, has an important place in the armamentarium of the science education researcher" (Fraser, 1978, p. 140). "Content analysis sets out to characterize, to condense and elucidate the content, to bring out the essentials or point out certain characteristics" (Findahl & Hoijer, 1981). This technique was selected as being the most appropriate to address the research questions and fulfill the purposes of the study. ERIC abstracts were used to conduct the analysis.

Articles were assessed for their main focus and placed into one of three

categories: teacher-centered, student-centered, or neither teacher-centered nor student-centered.

The articles were also classified if they presented science information from a specific content area. These articles were classified by the topics of astronomy/space science, biology, chemistry, physics, environmental education, or earth science. A third way of classifying articles dealt with the question of trends in education. Articles were categorized based on topics such as science activities, demonstrations, lecture method, science and society, females/sex differences, computer assisted instruction and others. This third aspect, unlike the first two, did not have to be the main point of the article, but that these areas be addressed in a meaningful way. Descriptors were useful in identifying these items.

An instrument was developed to assist in the content analysis. Defining criteria for each category were developed and used to categorize each article. Overall reliability was assessed by comparing rater observations (Slavin, 1992) and was found to be 0.97. To determine the validity of using ERIC abstracts rather than the actual NSTA journals for the content analysis, one year of feature articles for S&C and TST were also analyzed. The absolute percent differences between the abstract content analysis and the actual content analysis is as follows: (1) Main focus: S&C ± 7.6, TST± 6.3; (2) Science Content: S&C ± 9, TST± 3.7; and (3) Topics: S&C ± 3.7, TST± 2.1.

A total of 782 articles taken from the ERIC CD-rom database were analyzed. Each journal's abstracts were analyzed for the years 1970, 1975, 1980, 1985, and 1990. Trends that spanned part of or the entire twenty-year time frame were addressed. TJCST, however, was not available for 1970 and

therefore was not part of the sample. The number of articles in each journal from year to year fluctuated from 10 in S&C (1970) to 123 in TST (1975).

Results:

Due to the varying nature of the number of articles examined per type of journal and per year, the data has been transformed into percentages which are presented in table 1, 2, and 3.

In looking for contemporary trends an analysis of the most current year, 1990, is important. The majority of the articles for S&C (81.4%) and for TST (51.8%) promoted student-centered activities (table 1). The majority of articles in TJCST for this dimension fell into the neither category. In 1990, the most represented science content area was biology accounting for 38.1 percent for S&C, 30.6 percent for TST, and 40.6 percent for TJCST (table 2). During this same year, the three topics mentioned most in S&C are science activities (93%), audio-visual aids (23.3%), and computer assisted instruction (CAI) (16.3%). The items mentioned most in TST are science activities (57.7%), problem solving - critical thinking (13.5%), CAI (13.5%), and science and society (13.5%). For TJCST, the most mentioned areas are misconceptions (25%), CAI (12.5%), and problem solving - critical thinking (12.5%) (table 3). Results of years prior to 1990 can be found in tables 1-3. For analyzing trends, it is useful to look at changes over many years.

Megatrends

For this analysis, a megatrend is considered to be an area that has a consistent percent increase or decrease for at least four consecutive intervals ending with 1990. All three journals have megatrends in CAI (graph 1). For

Table 1. Main points of articles (by percent).

	Year and Journal															
Category	1970 S&C	1970 TST	1970 JCST	1975 S&C	1975 TST	1975 JCST	1980 S&C	1980 TST	1980 JCST	1985 S&C	1985 TST	1985 JCST	1990 S&C	1990 TST	1990 JCST	tot
% student centered	30	36.2	*	72.8	38.2	25.0	61.6	23.9	22.2	73.6	31.5	24.6	81.4	55.8	25.0	602
% teacher centered	20	23.4	*	7.4	36.6	9.7	6.8	34.8	18.5	9.4	40.7	41.0	4.7	25.0	32.5	311
% neither	50	40.4	*	19.8	25.2	65.3	31.5	41.3	59.3	17.0	27.8	34.4	14.0	19.2	42.5	488
Total Articles	10	47	*	81	123	72	73	46	27	53	54	61	43	52	40	782

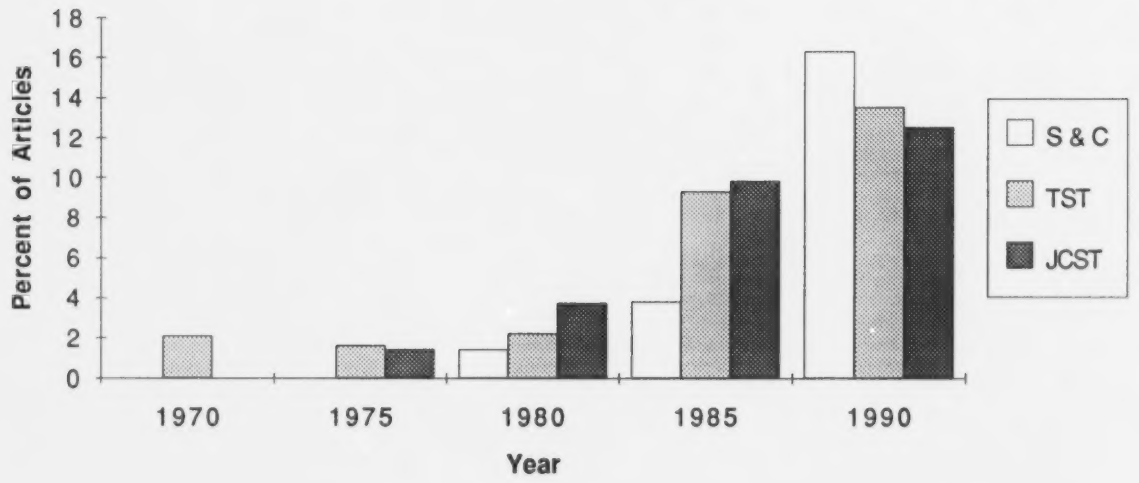
Table 2. Science content of articles (by percent).

	Year and Journal														
Type of Science	1970 S&C	1970 TST	1970 JCST	1975 S&C	1975 TST	1975 JCST	1980 S&C	1980 TST	1980 JCST	1985 S&C	1985 TST	1985 JCST	1990 S&C	1990 TST	1990 JCST
% Astron/space sci.	33.3	12.5	*	10.3	2.1	5.1	0.0	4.3	0.0	3.4	6.3	4.9	4.8	8.3	12.5
% Biology	0.0	29.2	*	31.0	23.6	29.5	43.1	34.8	22.2	65.5	26.6	31.7	38.1	30.6	40.6
% Chemistry	33.3	8.3	*	0.0	14.3	28.2	0.0	15.2	33.3	0.0	25.0	20.7	0.0	8.3	15.6
% earth	0.0	18.8	*	3.4	6.4	3.8	25.9	13.0	5.6	3.4	14.1	8.5	23.8	13.9	12.5
% Environmental	0.0	18.8	*	34.5	27.9	15.4	13.8	15.2	11.1	3.4	6.3	4.9	0.0	11.1	6.3
% Physics	33.3	12.5	*	20.7	25.7	17.9	17.2	17.4	27.8	24.1	21.9	29.3	33.3	27.8	12.5
Total Sci Report	3	24	*	29	70	39	29	23	18	29	32	41	21	36	16

Table 3. Content mentioned (by percent).

	Year and Journal															TOTALS		
	1970 S&C	1970 TST	1970 JCST	1975 S&C	1975 TST	1975 JCST	1980 S&C	1980 TST	1980 JCST	1985 S&C	1985 TST	1985 JCST	1990 S&C	1990 TST	1990 JCST	S&C	TST	JCST
Science Activities	60.0	31.9	*	72.8	34.1	20.8	68.5	17.4	22.2	83.0	27.8	9.8	93.0	57.7	10.0	76.5	##	##
demonstrations	10.0	2.1	*	2.5	4.9	0.0	1.4	0.0	0.0	1.9	3.7	9.8	2.3	7.7	2.5	2.3	4.0	3.5
lecture/recept. learn	10.0	0.0	*	0.0	0.8	1.4	2.7	0.0	7.4	3.8	1.9	3.3	0.0	0.0	5.0	1.9	0.6	3.5
field trips	0.0	6.4	*	4.9	4.9	2.8	20.5	0.0	0.0	9.4	7.4	0.0	4.7	3.8	0.0	10.0	4.7	1.0
a-v aids	10.0	0.0	*	6.2	6.5	9.7	4.1	0.0	7.4	3.8	0.0	4.9	23.3	3.8	5.0	8.1	3.1	7.0
prob sol/crit. think.	20.0	2.1	*	4.9	1.6	2.8	2.7	0.0	7.4	1.9	3.7	14.8	2.3	13.5	12.5	3.8	3.7	9.0
live animals	0.0	0.0	*	2.5	1.6	0.0	6.8	0.0	0.0	18.9	0.0	0.0	7.0	3.8	0.0	7.7	1.2	0.0
alternat. to dissect.	0.0	0.0	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.3	0.0
testing	10.0	2.1	*	0.0	1.6	11.1	2.7	0.0	11.1	0.0	0.0	3.3	4.7	1.9	7.5	1.9	1.2	8.0
integrat/interdis	0.0	12.8	*	9.9	5.7	12.5	11.0	6.5	0.0	5.7	0.0	4.9	7.0	9.6	10.0	8.5	6.5	8.0
cooperative learning	0.0	0.0	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.8	0.0	0.0
learning cycle	0.0	0.0	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	2.5	0.0	0.0	2.0
science & society	0.0	0.0	*	3.7	3.3	0.0	2.7	6.5	3.7	1.9	0.0	9.8	2.3	13.5	10.0	2.7	4.3	5.5
gender/ females	0.0	0.0	*	0.0	1.6	1.4	1.4	0.0	0.0	0.0	3.7	1.6	0.0	3.8	5.0	0.4	1.9	2.0
graphs	10.0	0.0	*	1.2	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	4.7	3.8	0.0	1.5	0.6	0.5
CAI	0.0	2.1	*	0.0	1.6	1.4	1.4	2.2	3.7	3.8	9.3	9.8	16.3	13.5	12.5	3.8	5.0	6.5
Reading/writing	10.0	0.0	*	2.5	4.1	0.0	12.3	4.3	0.0	1.9	5.6	0.0	14.0	0.0	7.5	7.3	3.1	1.5
Misconceptions	0.0	0.0	*	0.0	2.4	0.0	4.0	12.5	0.0	2.3	6.7	16.7	0.0	13.3	25.0	1.5	6.4	6.5
Parents	0.0	0.0	*	0.0	0.0	0.0	5.5	0.0	0.0	1.9	0.0	0.0	2.3	0.0	0.0	2.3	0.0	0.0
Homework	0.0	0.0	*	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	1.0

Graph 1. Computer Assisted Instruction by Journal and Year.



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S&C, this and a percentage decrease in environmental education articles are the only megatrends. For TST, the increase in percentage of articles related to astronomy/space science is a megatrend. For TJCST, megatrends are found in CAI, science and society, and earth science, all of which increased.

Trends

For this analysis, a trend is considered to be a consecutive increase or decrease in percentage for the years 1980, 1985, and 1990. Megatrends fit into this category, but are not mentioned again to avoid redundancy. The increasing trends for S&C include astronomy, physics, student-centered instruction, and science activities. The decreasing trends for S&C include field trips and articles in the neither student-centered or teacher-centered category.

For TST the increasing trends include physics, problem solving, science activities, gender/female issues, demonstrations, and articles that promote student-centered instruction. The decreasing trends include articles in the neither student-centered nor teacher-centered categories.

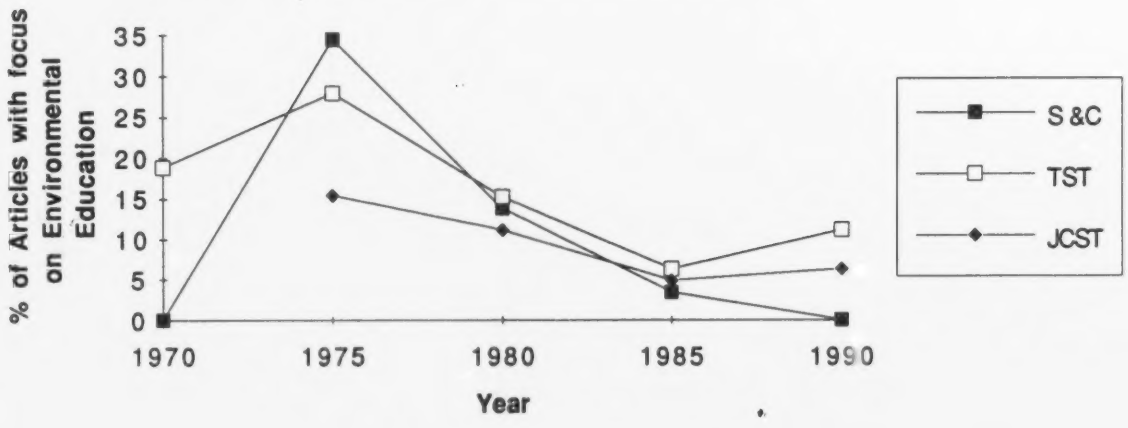
In TJCST, the increasing trends include gender, misconceptions, and articles dealing with biological topics. The percentage of science articles dealing with chemistry is a decreasing trend.

Other interesting changes.

The percentage of articles dealing with environmental issues peaks in 1975 for all three journals (graph 2). All the journals show declines for the next decade. TST and TJCST show an increase in the next five year interval (1985-1990).

Articles dealing with astronomy and space science appear more frequently

Graph 2. Environmental Education.



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in the 1970s than they do in the 1980s. In all three journals, the percentage of articles devoted to space sciences show increases in 1990.

The Journals compared.

In this section all of the years are consolidated so that the journals can be compared with each other. Science content is compared in graph 3. Biology makes up the largest percentage of all science topics for each journal. Astronomy and space science make up the smallest percentage. The amount of chemistry increases as the grade level of instruction increases; S&C has 0.9 percent chemistry, TST has 14.3 percent, and TJCST has 24.6 percent. The amount of earth science shows a reverse trend with more presented for teachers at the elementary level, decreasing at the high school and college levels.

A larger percentage of articles in S&C mention field trips than TST, which has a higher percent than TJCST (see graph 4). The highest percentage of articles on demonstrations is found in TST, the highest percentage on lectures is in TJCST. TJCST has a higher percentage of articles on science and society which is the ERIC descriptor for what is more commonly referred to as Science, Technology and Society (graph 4).

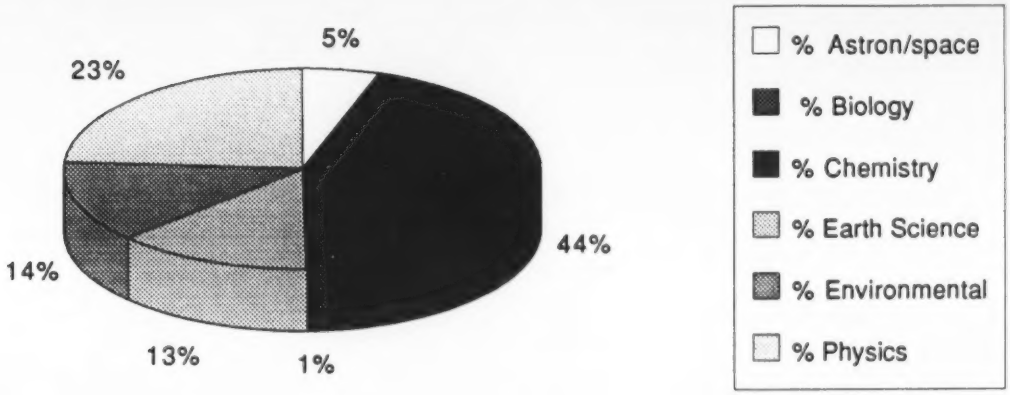
The college journal has a higher percentage of articles dealing with problem solving, CAI, homework, and testing than the other two journals (graph 5). No articles on homework were found in S&C or TST.

Discussion.

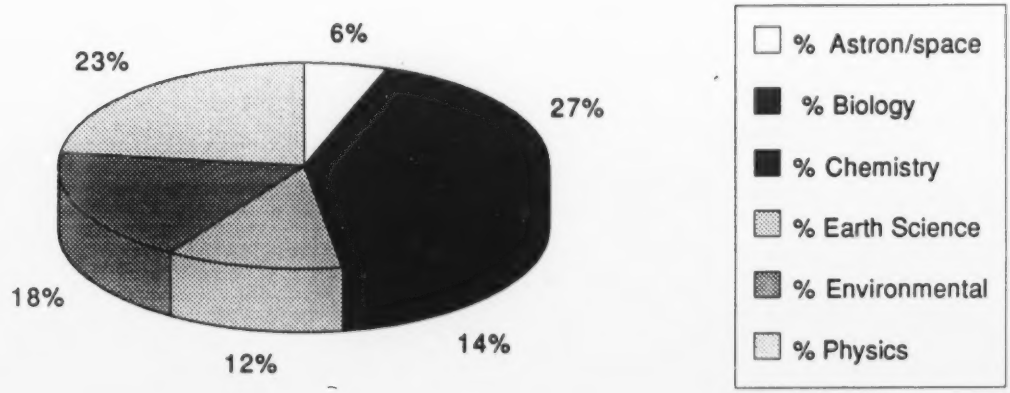
Student-centered instruction is getting good coverage in all three journals. Teachers at the elementary and high school level are also receiving an abundant supply of suggested science activities (graph 6). This is consistent with research

Graph 3. Science by Journals (1970-1990)

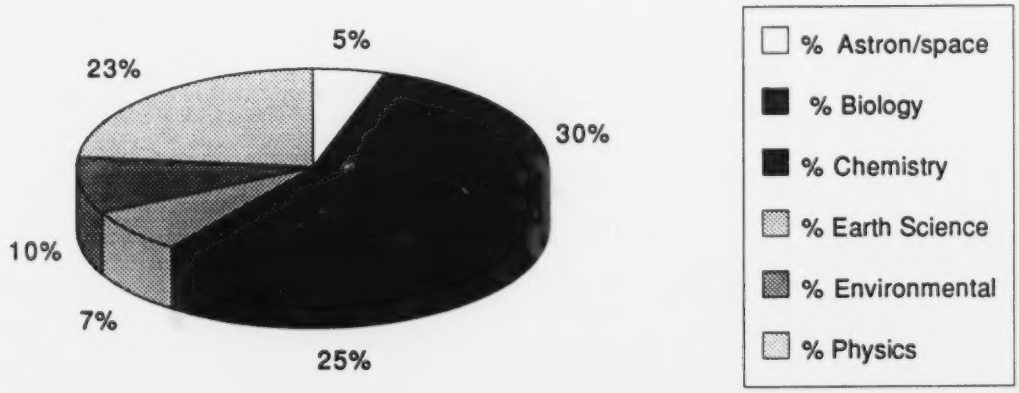
Science and Children



The Science Teacher



Journal of College Science Teaching



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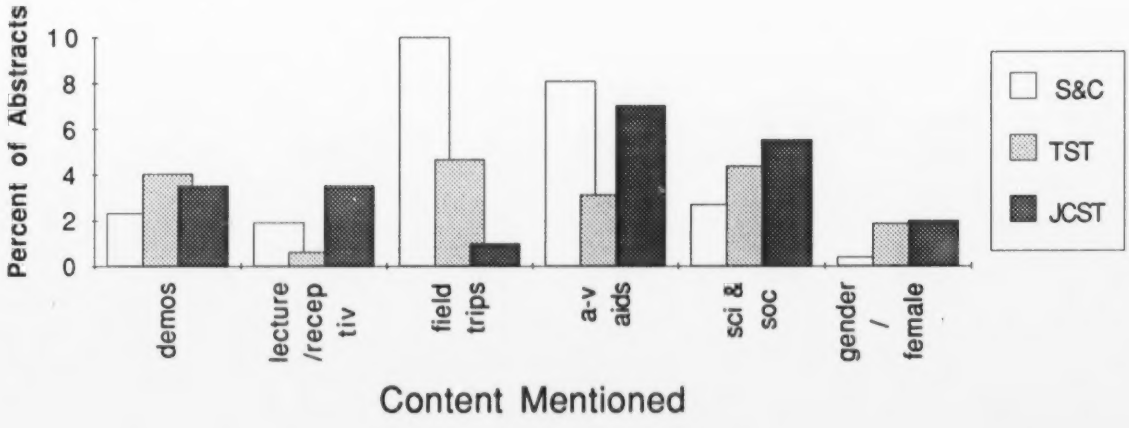
Graph 4. Content Mentioned in Journals.



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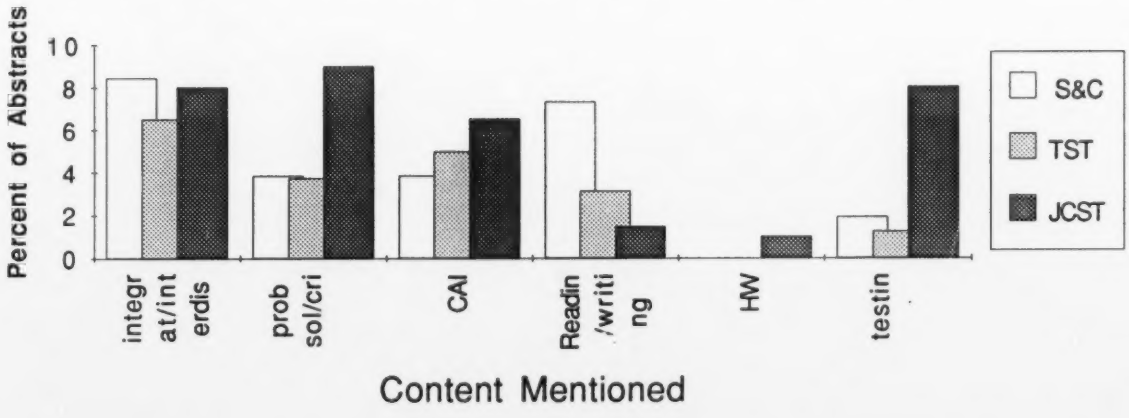
Graph 5. Content Mentioned in Journals



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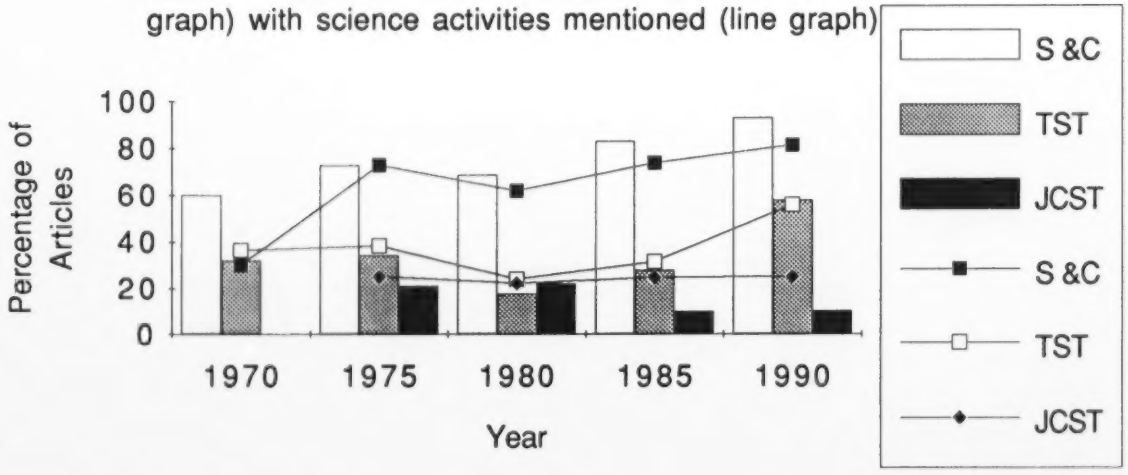
Graph 6. Student centered articles as the main point (bar graph) with science activities mentioned (line graph)



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findings indicating the effectiveness of student-centered learning and a hands-on, minds-on approach (Lloyd & Contreras, 1987; Donnellan & Roberts, 1985; Shymansky & Penick, 1981; Bredderman, 1984). S&C, which is aimed at elementary school teachers, contains more science activities than the other journals. This is appropriate considering research findings that concrete operational students benefit the most from laboratory or other hands-on activities (Blosser, 1988). The other areas that appear to be getting adequate coverage in all journals are CAI, biology, and physics.

Some areas that would seem to be important to science teachers have been overlooked. For example, homework articles only appeared in the journal for college teachers. This is troubling, since homework is an important part of science education. According to the NAEP 1986 assessment, in grade 11, there is a consistent positive relationship between time spent on science homework and achievement in science (Mullis & Jenkins, 1988). This suggests homework can be effective in science learning. However, "homework assignments and workbooks for American children are often criticized as shallow, boring, and repetitious" (Stevenson & Stigler, 1992, p. 68). Articles on effective homework assignments would certainly be of help to all teachers.

The percentage of articles on testing by S&C and TST also seems to be small. Evaluation is a topic which is of increasing concern to educators. "Because of the demonstrated driving force of assessment on the curriculum, it is imperative that methods of assessment be reformed at the same time that approaches to teaching and learning science are being changed" (Tobin, 1988, p. 412).

The "L" word.

While we fully support the emphasis on promoting student-centered instruction, we also realize this is not what occurs in the majority of classrooms. According to the 1985-86 National Survey of Science and Mathematics Education the percentage of classes using lectures as reported by teachers is 71 for grades K-3, 78 for grades 4-6, 83 for grades 7-9 and 84 percent for grades 10-12 (Weiss, 1989). Even though the lecture method dominates in all levels of science instruction, and is an ERIC descriptor, it is never applied to articles in S&C and TST. The avoidance of the term "lecture" and the absence of advice on how to do it well, or to modify it for more student involvement, seem to be a symptom of "science education correctness." Perhaps some feel that if it is not talked about it will go away. Yet, science education has experienced the forces of the enlightenment, object teaching, nature study, and the NSF funded curriculum, and still the lecture prevails. We support efforts to change the dominance of the lecture, but we also feel that if a teacher is going to hold a lecture they should be guided into doing it well. Ausubel (1961) indicated that criticisms of the lecture method are not in doing it, but the abuse of the method. Focusing on meaningful learning rather than rote learning is a way to improve the lecture method (Collette & Chiappetta, 1986). "Since both teachers and prospective teachers are influenced by what is published in professional journals, the authors who write for these journals and the editors who select what is published have an obligation to incorporate research-based practices for wherever it is appropriate" (Cruickshank, 1990, p. 64). For example, research studies have shown that the type of questions a teachers asks and their question asking behaviors can influence

student achievement and higher-level thinking (Blosser, 1988). This type of information could help traditional teachers teach better.

Science Content

It seems that the editors and reviewers do seek to maintain a spread of science content. However, the amount of chemistry mentioned at the elementary level is minimal.

The trend of increased percentages of articles on astronomy and space science reflect a renewed interest in space exploration. The decrease in space science coverage in the early 1980s probably reflects a period of less inspiring space exploration. In this period planetary exploration was stopped and a space station abandoned. We feel the student's interests should help guide the presentation of science and it is appropriate that the amount of articles on space science should be influenced by how much excitement is being generated by space exploration by NASA and other space exploration organizations.

The decreasing emphasis on environmental education during the 1980s was unfortunate. The political winds of that era not only negatively impacted the environment, but also environmental education. Some themes, such as environmental education, should be present regardless of who holds political office and regardless of the price of a gallon of gas.

Limitations

Using ERIC abstracts for a content analysis requires reliance on the abstracters abilities and the abstracting process. Thus, the quality of the abstracts is still a potential limitation.

Some of the articles were not abstracted by ERIC making the sample

incomplete. Only a partial year was abstracted in S&C for 1970, and no JCST articles were abstracted for 1970.

The content analysis was based in part on descriptors, some of which came into being after the beginning of the time frame considered. This was compensated for the using the entire abstract to decide the content of the articles. Finally, we randomly chose every fifth year for this content analysis. We make the assumption that these years are typical of their surrounding years.

Conclusion

These NSTA journals reflect current thinking on how science should be taught. There is, however, a disparity between journal content and actual classroom practice. For both preservice and inservice teacher education, these journals would not appear to be useful in helping teachers in some areas, for example, homework assignments and tests. These journals are an excellent source for student-centered instruction and for science activities. The high percentage of agreement between actual ERIC abstracts and actual NSTA feature articles provides quantitative evidence that the ERIC system can be an efficient way for teachers to find science education articles on various topics.

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